

## Questions and Answers

### 1. What is perchlorate?

Perchlorate is a man-made salt (i.e., ammonium, potassium, magnesium or sodium salt) that dissociates to form a relatively stable anion ( $\text{ClO}_4^-$ ). Perchlorate is also naturally occurring in some specific situations, e.g., Chilean nitrate deposits. Perchlorate is highly soluble in water, non-volatile, and not affected by pH and temperature. As an oxidant, perchlorate is kinetically non-labile. Natural chemical reduction in the environment is not expected to be significant. Therefore, perchlorate may persist for many decades under typical underground water and surface water conditions.

### 2. What are the sources of perchlorate contamination?

Ammonium perchlorate ( $\text{NH}_4\text{ClO}_4$ ) has been used as the principal component in rocket fuel, highway flares and fireworks. It is also used in munitions. Solid rocket fuel containing ammonium perchlorate has a finite shelf life, and this rocket fuel had to be periodically flushed from missiles and rockets and replaced with a fresh supply. This periodic flushing and replacement of rocket fuel since the 1950s has generated substantial quantities of waste perchlorate requiring disposal. Some of this waste perchlorate has leached into soil and aquifers used for drinking or irrigation.

Other minor sources include the use of fertilizers imported from Chile and the industrial use of perchlorate salts as an additive in lubricating oils, tanning and finishing leather, and paints, and in analytical chemistry laboratories.

### 3. What geographical areas are known to be contaminated with perchlorate?

Most areas where perchlorate has been detected are associated with facilities that have manufactured, tested, or disposed of solid rocket fuels, explosives, fireworks, and highway flares. The U.S. Environmental Protection Agency (U.S. EPA) has identified such facilities in 39 states. Thus, perchlorate contamination is a national issue.

In California, documented areas of contamination include:

- 1) Eastern Sacramento County, near Aerojet General Corporation's facility near Rancho Cordova,
- 2) Placer County, at an explosive manufacturing facility near Lincoln,
- 3) Santa Clara County, at United Technologies and Olin Corp.
- 4) San Benito County, at the Whittaker Ordinance Facility near Hollister,
- 5) Los Angeles County, at an Aerojet Facility in Azusa, Whittaker-Bermite site in Santa Clarita and the Jet Propulsion Laboratory in Pasadena,

- 6) San Bernardino County, at Lockheed Propulsion Company and near a defunct fireworks site near Rialto,
- 7) Some parts of Riverside County.
- 8) Lower Colorado River.

Ongoing perchlorate contamination of the Colorado River originates from an ammonium perchlorate manufacturing site near Las Vegas, Nevada. As a result of this ongoing contamination in Nevada, the water of the lower Colorado River has been reported to contain from 5 to 9 parts per billion (ppb, ug/liter) of perchlorate. The Colorado River supplies drinking water to much of Southern California. Colorado River water is also used for irrigating food crops in almost one million acres of farmland in California and Arizona.

4. Does perchlorate pose a health risk?

Perchlorate disrupts iodine uptake in the thyroid gland. Because iodine is an essential component of thyroid hormones, this disruption may cause serious adverse health effects. In adults, the thyroid gland helps regulate metabolism. In children, the thyroid gland plays a vital role in development as well as regulating metabolism. In expectant mothers, impairment of thyroid function can impact the fetus resulting in behavioral changes, delayed development, and mental retardation. Chronic overstimulation of the thyroid gland—as it attempts to compensate for inadequate iodine—also could occur, possibly leading to thyroid tumors.

5. Who are the people that are particularly at risk?

Pregnant women's developing fetuses, as well as infants, are most vulnerable to the effects of perchlorate.

6. What are the public health goals (PHG) and allowable levels of perchlorate in drinking water and food crops?

In March 2002, the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) proposed a PHG of perchlorate in drinking water of 6 ppb based on the inhibitory effect of perchlorate on the uptake of iodide by the thyroid gland. Subsequently, in December 2002, OEHHA revised its draft PHG to 2-6 ppb. In early 2002, U.S. EPA published a document proposing a reference dose of 0.00003 mg/kg-day and a human health-protective drinking water equivalent level (DWEL) of 1 ppb for perchlorate. U.S. EPA forwarded the document in March, 2003 to the National Academy of Sciences for review and recommendations. Both the proposed PHG and DWEL are still under review and have not yet been finalized.

A maximum contaminant level (MCL) has not yet been established for perchlorate in drinking water. However, the California Department of Health

Services (CDHS)' Division of Drinking Water and Environmental Management (DDWEM) uses a 4-ppb action level for perchlorate in drinking water, a concentration that corresponds to its detection limit for purpose of reporting. Action Levels are advisory levels and not enforceable standards. If perchlorate is detected in a well at a level greater than its action level, there is a statutory requirement that the water system must notify local government bodies (e.g., city council and county board of supervisors) about the presence of perchlorate, even if the well is taken out of service. DDWEM also recommends that the water system inform customers and consumers about the presence of perchlorate, and its potential for adverse health effects.

At a perchlorate level of 40 ppb, DDWEM recommends that the water system remove the source from service. DDWEM plans to establish a MCL for perchlorate for drinking water once the OEHHA's PHG is finalized. An MCL is required by state law by January 1, 2004.

Currently, there is no standard for perchlorate in food other than the general provisions for adulterated food in the Sherman Food, Drug, and Cosmetic Law, California Health and Safety Code, Division 104, Part 5, Section 110545: "Any food is adulterated if it bears or contains any poisonous or deleterious substance that may render it injurious to health of man or any other animal that may consume it." Since there are few, if any, scientific studies or risk assessments on perchlorate in food, the levels of perchlorate in foods that may cause food to be "adulterated" are currently unknown.

7. Would food crops grown with perchlorate-tainted water present a health risk?

The only known credible study pertinent to this question is that of the U.S. EPA on lettuce grown in a green house in the late 1990s (by hydroponics with nutrient solutions containing various concentrations of perchlorate: Preliminary study). Since then, the Air Force has funded a second study of the green-house-grown lettuce and its results are still being reviewed (no report available to date). Another study was completed by Lucky Farms on its produce grown in Redlands, California in 1997 and 1998. The CDHS' Food and Drug Branch (FDB) received the Lucky Farms' data via the Environmental Working Group (EWG) and the Regional Water Quality Control Board-Region 8. However, FDB could not adequately assess the Lucky Farms' data because the study lacked details, and no sampling protocol or analytical methods used for the study were available.

The findings of the U.S. EPA's Preliminary Study indicated that perchlorate-contaminated irrigation water might be an available source of uptake of perchlorate by produce. However, the agency cautioned that the findings must not be used to determine the magnitude of their relative public health risk because there are many questions and unknowns regarding the study. The U.S.

EPA has developed a protocol for a follow-up study (field trials), but has not initiated field trials.

In April, 2003, EWG reported that four out of twenty two lettuce samples collected from supermarkets during the winter lettuce harvest season contained measurable levels of perchlorate ranging from 30 ppb to 120 ppb with a median value of 70 ppb. However, it is premature to draw any conclusions from these test data because the sample size used for the study was too small and EWG could not identify exactly where the lettuce came from. A large scale, scientific risk assessment study will be needed to evaluate the risk.

Because there are no credible and reliable quantitative field data or studies, the safety of food crops grown with perchlorate contaminated irrigation water (whether from the Colorado River or from perchlorate-contaminated ground water) cannot be adequately assessed at this time.

8. Some studies report perchlorate results on a "wet weight basis" (or "as consumed"), while others report their results on a "dry weight basis." Can these results be compared?

Scientists generally report data on perchlorate in vegetation on a dry weight basis to allow comparison within a single study or among different studies. Moisture content of lettuces varies from 92 to 96 percent depending upon variety (e.g., romain, iceberg, butterhead, etc.), harvesting time (e.g., winter, spring, summer, or fall), processing, packaging, and storage conditions.

The data presented on a dry weight basis would need to be converted back to a "wet weight" value in order to provide an estimate of perchlorate intake by consumers.

The following formula can be used to convert the dry weight based perchlorate concentration to the wet weight based perchlorate concentration that is more helpful in assessing dietary intake:

$$P \times (100 - M)/100 = Q$$

Where,

- P is the perchlorate in food on dry weight basis (i.e., micrograms of perchlorate per kilogram of food (µg/kg))
- M is the percent moisture of the food—this can be determined in the laboratory, or the average value of a food can be obtained from the USDA website: <http://warp.nal.usda.gov/fnic/foodcomp/Data/SR14/wtrank/sr14a255.pdf>
- Q is the perchlorate concentration of the food on a wet weight basis (µg/kg).

For example, if a particular lettuce is reported to contain 200 µg/kg perchlorate on a dry weight basis, and if it has 96% moisture, a wet-weight concentration of 8 µg/kg perchlorate is derived  $[200 \times (100-96)/100 = 8]$ .

This value of 8 µg/kg then can be used to estimate perchlorate intake, using an appropriate serving size for lettuce. If a serving size of lettuce weighs 100 grams (or 0.1 kg), then the perchlorate intake per serving would be 0.8 µg ( $8 \mu\text{g/kg} \times 0.1 \text{ kg} = 0.8 \mu\text{g}$ ).

9. Do regulatory agencies have methods to determine the level of perchlorate in food?

There are no validated, approved methods for detection and quantitation of perchlorate in food. The methods needed for detection and quantitation of perchlorate in food are substantially different from those used for water. The U.S. Food and Drug Administration (FDA) is evaluating methods for perchlorate detection in food. Additionally, CDHS is developing and validating new laboratory methods for detection and quantitation of perchlorate in food.

10. What are the current CDHS activities on perchlorate in foods?

FDB is working with the Regional Water Quality Control Boards, Agricultural Commissioner's office in various counties, and local water districts to locate the private wells in the affected areas, obtain perchlorate data from each well, types of crops grown in the affected areas, and growers' information (name, phone number, address). The information will be entered in a GIS (Geographic Information System).

FDB is developing and validating new laboratory methods for detection and quantitation of perchlorate in foods. FDB is working with FDA in designing a plan for a risk assessment of perchlorate in foods.

11. Do you have website links that will lead to more information on perchlorate in drinking water and toxicology?

The state and U.S. EPA websites below will provide more information on perchlorate in drinking water and toxicology:

<http://www.dhs.ca.gov/applications/search/search.asp?advanced=yes&ct=DHS%2CRFP%2CRegulations%2CPressReleases%2CHealthCommPortalInternet&q1=perchlorate&I2=Search>

[http://www.oehha.org/public\\_info/facts/perchloratefacts.html](http://www.oehha.org/public_info/facts/perchloratefacts.html)

<http://www.epa.gov/ncea/perch.htm>

<http://cfpub.epa.gov/ncea/cfm/perch.cfm?ActType=default>

[http://www.epa.gov/swerffrr/documents/perchlorate\\_qa.htm](http://www.epa.gov/swerffrr/documents/perchlorate_qa.htm)

<http://www.epa.gov/safewater/methods/met314.pdf>

<http://www.epa.gov/safewater/standard/ucmr/aprvlabs.html>

<http://www.epa.gov/safewater/ccl/perchlorate/perchlo.html>